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[54] Description of invention: early- and final-phase high-strength Portland cement and its formulation

[57] Abstract

This invention offers a kind of early- and final-phase high-strength Portland cement and its formulation. It uses the raw materials and processes for producing common Portland cement; however, it emphatically modifies the relation between "three rates" of KH0.905-0.930, n1.80-1.94 and P1.40-1.60, and adopts fluorite as mineralizing agent, and $CaSO_4 \cdot 2H_2O$ as retarder. The compression strength of this cement is 496-503kg/cm^2 in three days, and 779-785kg/cm^2 in 28 days. Its early-phase strength improvement rate is 63-68% in 3/28 days. It can be used in construction of common buildings, airport runways, bridges, channels, and emergency repair works. Since the range of firing temperature of this invention is wide, the energy consumption and production cost can be considerably reduced.

(BJ) # 1456

Right Request

① The early- and final-phase high-strength Portland cement is composed of C_3S, C_2S, C_3A and C_4AF. It is featured with KH of 0.905-0.930, n of 1.80-1.94, and P of 1.40 –1.60. The mineral contents of the clinker are as follows (by weight) : C_3S 56.00-58.50%, C_2S 14.00-17.00%, C_3A 8.00-10.50%, and C_4AF 11.00-13.50%.

② The Portland cement described in ① has the following chemical proportions (percentage): SiO_2 20.20-21.50%, Al_2O_3 6.20-6.80%, Fe_2O_3 4.1-4.45%, CaO 64.00-65.50%, MgO 2.50-3.10%, SO_3 1.20-1.50%, and CaF_2 0.30-0.60%.

③ The Portland cement described in ② is featured with addition of $CaSO_4 \cdot 2H_2O$ 4.50-6.00% (weight percentage) in the clinker.

④ The formulation of the early- and final-phase high-strength Portland cement is characterized with addition of 0.45-0.90% (weight percentage) CaF_2 as mineralizing agent to the raw materials.

⑤ The formulation of the early- and final-phase high-strength Portland cement described by ④ is a liquid phase rate of 22.0-23.5% by C_3A + C_4AF.

Statement

Early- and final-phase high-strength Portland cement and its formulation

This invention belongs to the building material & technology industry.

Portland cement is the most widely and largely used cement worldwide. Particularly in the field of civil construction, Portland cement is widely used as the major building material.

The raw materials of Portland cement are easy to obtain, and its production technology is mature. However, its early- and final-phase strength, compared with that of special high-strength cement products, is not good enough.

According to the Selections of New Cement Standards (issued by the Cement Research Office under the State Building Material Research Institute in January 1985, "compared with cement products of other countries, Chinese cement products are weak in early-phase strength. It is difficult, or impossible, for most plants to improve the early-phase strength indices." To meet the international standards, it is important to improve our early-phase strength indices.

The first volume of Physical Performance of and Inspection on Cement (published by the Cement Research Office under the State Building Material Research Institute in June 1982) puts forward in Section One "Silicate Cement" of Chapter Two that the compression strength of Wu Yang Portland cement exported to overseas markets can reach 50-70% of that of 28 days in three days, and 73-78% of that of 28 days in seven days. Compared with cement blended with compound materials, Wu Yang Portland cement maintains higher early-phase strength; however, compared with special cement with high early and final-phase high strength, such as cement with high aluminum content and sulphate or aluminate cement, it maintains lower strength.

The Cementing Medium described in SU-639828 issued on December 30, 1978 is Portland cement plus gesso and additive made of silicate material by chemical treatment at a high temperature. Its compression strength reaches 270kg/cm^2 in three days and 566kg/cm^2 in 28 days. This Portland cement with additive needs thermochemical treatment and has complicated production technology, and its early- and final-phase strength is similar to that of our #525 Portland cement.

The Cement Compound described in JP-80011632 issued on March 26, 1980 is Portland cement plus calcium aluminate, calcium sulphate and sodium carbonate. Its compression strength is

205kg/cm^2 in one day and 512kg/cm^2 in 28 days. The quick strength of this cement in two or five hours is high, but its early-phase and final-phase strength is low, similar to the standard of our #425 quick hardening Portland cement.

The High-strength Cement described in JP-8004698 issued on November 27, 1980 is Portland cement plus calcium aluminate and calcium sulphate. Its compression strength is 396kg/cm^2 in one day and 574kg/cm^2 in the final phase. The cement hardens quickly, exceeding the standard of our #425 Portland cement, but its final-phase strength is not high.

The Production of High-strength Mortar and Concrete described in JP-56017959 issued on February 20, 1981 describes Portland cement plus specially hard gesso, SiO_2, and alumina, which are blended to produce mortar, and the mortar is heated at 50-100°C. Its early-phase strength is 439kg/cm^2 in three days and 679kg/cm^2 in final phase. Its early-phase strength has been improved by 65%. The cement made this way maintains improved early- and final-phase strength, similar to the standard of our #628 Portland cement. However, its mortar has to be heated, making things inconvenient in construction.

The Cementing Medium described in SU-854906 issued on August 15, 1981 is Portland cement clinker plus metals containing alkali or alkaline earth, lignin sulphate, alkali metallic carbonate or silicate, and monose, to improve the compression strength of concrete after vapor maintenance. Its compression strength reaches 675kg/cm^2 in one day and 708kg/cm^2 in 28 days. This cement has high one-day strength, but slow improvement of strength after one day, similar to the standard of our #625 Portland cement. Since the cement has many additives, its manufacturing process is complicated; plus, the additives are high-price chemical raw materials, so the production price of the cement is high.

The Production of Early-phase High-strength Cement described in JP-82002667 issued on January 18, 1982 describes the cement process: produce special cement clinker without C_3S at first, and then add 70% Portland cement. The cement made this way maintains the compression strength of 175kg/cm^2 in three days and 395kg/cm^2 in 28 days. Its early-phase strength improvement rate is 44%. The early-phase strength of the cement made this way is improved to some extent, but its final-phase strength is just equal to that of common Portland cement. Further, its production process is extremely complicated.

The common feature of the Portland cement products described in the above-mentioned overseas patent documents is that their construction performance is generally good. Some efforts have been made in improving the early- and final-phase strength of Portland cement in some foreign countries, but that's still not enough. For instance, some cement products maintain high final-phase strength but low early-phase strength. Further, for the purpose of quick hardening and high early-phase strength, quick hardening or early-phase strength additives are added to the Portland cement or clinker, resulting in complicated production process. Some additives are valuable chemical raw materials, considerably raising the production cost.

With high 2-hour, 5-hour and 1-day strength, these cement products are suitable only to projects with the requirement of quick hardening. However, their 3-day and 28-day strength is not high, so they can hardly be used widely. Some of these cement products need to be heated at 50-100°C to improve quick hardening or early-phase strength, which makes things extremely inconvenient in construction.

It was a blank field in improving the performance of Portland cement clinker with common raw materials and production process of Portland cement clinker, and achieving two important characteristics of Portland cement, namely, quick hardening and high early- and final-phase strength, without using any additive.

The inventor has made this invention through researches and developments in this respect.

One purpose of the invention is to develop a kind of Portland cement with high early- and final-phase strength, and another is to provide the formulation of this Portland cement.

This invention achieves the two purposes in the following. The key point to obtain quick hardening and high early- and final-phase strength of Portland cement and raise the early-phase strength improvement rate is to properly arrange the relation between three rates, namely, KH, n and P. We keep two of the rates high and one low: KH 0.905-0.930, n 1.80-1.94, and P 1.40-1.60. Meanwhile, we choose C_3S, C_2S, C_3A and C_4AF as the major minerals, and arrange a proper proportion between them. The clinker is composed of the following (in weight percentage): C_3S 56.00-68.50%, C_2S 14.00-17.00%, C_3A 8.00-10.50%, C_4AF 11.00-13.50%, and MgO plus others 2.50-3.94%.

This invention adopts high lime saturation rate and C_3S proportion. Due to the quick hardening of C_3S hydrate and the reasonable proportion between the four major minerals, both the early and final phase strength of Portland cement can be improved.

The chemical components of clinker are controlled as follows (weight percentage): SiO_2 20.20-21.50%, Ai_2O_3, 6.20-6.80%, Fe_2O_3 4.1-4.45%, CaO 64.00-65.50%, MgO 2.50-3.10%, SO_3 1.20-1.50%, and CaF_2 0.30-0.60%. What is added to clinker is $CaSO_4 \cdot 2H_2O$ 4.50-6.00%.

Raise of lime saturation rate often brings about difficulty in firing, thus making it impossible to obtain high-strength clinker. To resolve this issue, this invention adopts mineralizing agent. The following Table 1 shows the results of addition of the agent of CaF_2 by 0.45-0.90%.

Table 1: Compression strength, antiflex strength and early-phase strength improvement rate by three different mineralizing agents

Name of	Compression strength (kg/cm_2)	Early-phase	Antiflex strength (kg/cm_2)	Early-phase

mineralizing agent	3 days	7 days	28 days	strength improvement rate (%)	3 days	7 days	28 days	strength improvement rate (%)
$CaSO_4 \cdot 2H_2O$	496	606	785	63	67	77	84	78
Gesso and fluorite	496	612	722	68	73	87	92	79
Fluorite	503	634	779	65	79	88	100	79

By adding 0.45-0.90% CaF_2 as mineralizing agent to this invention, the firing temperature is reduced by 110-120°C or so. As a result, the liquid phase appears in advance, and C_2S and CaO combine to produce a large amount of C_3S. Meanwhile, sufficient amount of liquid phase is available, so that the sum of $C_3A + C_4AF$ keeps between 22.0-23.5%.

With proper amount of C_3A and a small amount of C_4AF, the amount of iron is controlled, thus avoiding production of large melting clumps and reducing tumors.

Proper amount of C_3A (8.0-10.5%) is a very important factor that makes Portland cement harden quickly. It also assures sufficient early-phase strength. However, over amount of C_3A will cause viscosity of liquid phase, which makes it difficult for C_3S to survive.

In this invention, $CaSO_4 \cdot 2H_2O$ shall also be added to the clinker as retarder, so that the initial setting time will be 45 minutes or later. The content of SO_3 in Portland cement shall be no more than 3.5%, and the proper amount of $CaSO_4 \cdot 2H_2O$ in Portland cement shall be 4.50-6.00%.The following Table 2 shows the physical performance of the cement of this invention obtained through test to our national standards.

Table 2: Test data about physical performance of the cement of this invention

Standard viscosity (%)	settinging time (hour:minute)		Stability	Strength (kg/cm_2)					
				Compression strength			Antiflex strength		
	Initial setting	Final setting		3 days	7 days	28 days	3 days	7 days	28 days
29.00	1:12	1:42	Ok	503	634	779	79	88	300

The following Table 3 shows the comparisons of the cement formulated in line with this invention and #725 early-phase strength Portland cement in respect of compression strength, antiflex strength and early-phase strength improvement rate.

Table 3: comparisons of two kinds of cement in respect of compression strength, antiflex strength

and early-phase strength improvement rate

Name or # of cement	Compression strength (kg/cm_2)			Early-phase strength improvement rate (%)	Antiflex strength (kg/cm_2)			Early-phase strength improvement rate (%)
	3 days	7 days	28 days		3 days	7 days	28 days	
New #725B Portland cement	377		725	52	63		88	72
This invention	503	634	779	65	79	88	100	79

Comparing the cement of this invention and the new #725 early-phase cement, the 3-day early-phase compression strength of the former is higher by 126kg/cm_2 than that of the latter, and the antiflex strength of the former is higher by 16kg/cm^2 than that of the latter. Plus, the early-phase strength improvement rate of the invention exceeds the average level in China (which is 49.8%) as well as the average level of the world (which is 52%).

This invention was tested in Zunyi Shizi Cement Plant before the feeding facilities and raw material and clinker storage facilities were installed. The following Table 4 shows the results of the test done to our national standards.

Table 4: Physical performance data of this invention obtained in the cement industry test (in the above-mentioned conditions)

Standard viscosity (%)	Setting time (hour:minute)		Stability	Fineness (%)	Dissociative calcium (%)	Strength (kg/cm_2)					
						Compression strength			Antiflex strength		
	initial setting	Final setting				3 days	7 days	28 days	3 days	7 days	28 days
26	1:19	3:15	Ok	12	2.7	428	554	763	62.8	71	90.8

The best way to achieve this invention:

1. KH0.910-0.920, n1.80-1.90 and P1.40-1.50
2. Composition of clinker minerals (weight percentage): C_3S 56.00-57.00%, C_2S 14.00-15.00%, C_3A 8.00-9.00%, and C_4AF 12.00-13.00%, and MgO plus others 2.50-3.00%

This invention improves the performance of Portland cement, and maintains two important features: quick hardening and high early- and final-phase strength. It is a new hydraulic gelatification material. Its 3-day early-phase strength is higher than that of quickly hardening Portland cement, and its 28-day final-phase strength is higher than that of aluminate cement. The Portland cement of this invention maintains outstanding physical performance and special value of

application. It can be used in construction of buildings and prefabrications, and together with high-standard concrete, it can be used in construction of airport runways, bridges, channels, and emergency repair works.

To produce the cement of this invention, it is not necessary to add any quickly hardening or early-phase strength additive, and it is not necessary to heat the mortar either. Further, the production process is simple, and the previous Portland cement production facilities can be used to produce the cement of this invention.

The cement of this invention is featured with high early-strength as well as outstanding stability and construction performance. Therefore, project construction can be accelerated, thus shortening the construction period and construction cost.

High-grade mixed cement can be produced with the cement clinker of this invention plus some other materials, thus improving product grade or production output. This way, energy consumption can be considerably saved, and production cost saved. Both the production plants and users can enjoy remarkable social and economic effects from this invention.

Ferromanganese slag containing SiO_2 38.11%, Ai_2O_3 27.70%, Fe_2O_3 0.36%, CaO 16.83%, MgO 5.54%, and MnO 7.00% and with quality coefficient of 1.11 (lower than the national standard) can be added to the clinker of this invention.

Cases:

By combining 60% cement clinker of this invention with 40% ferromanganese slag containing the chemicals described above, we can produce slag cement #625.

45% cement clinker of this invention is blended with 55% slag to produce #525 slag cement. A cement plant with existing annual production capability of 100,000t #525 Portland cement can use the cement clinker of this invention and add 55% slag to produce 223,000t #525 cement per year. For another example, by adding 55% slag to #525 Portland cement clinker, a cement plant with an existing annual production capability of 100,000t #325 slag cement can use the cement clinker of this invention to produce 100,000t #525 slag cement. This way, the cement grade can be improved and energy saved.

When the cement clinker of this invention is mixed with other materials to produced mixed cement, the use of gesso shall be reduced accordingly.

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[54]发明名称 早期和终期高强度波特兰水泥及其配料方法

[57]摘要

本发明提供了一种早期和终期高强度的波特兰水泥及其配料方法，它使用了一般生产波特兰水泥熟料的原料和工艺，着重调整好"三率值"关系：KH0.905～0.930、n1.80～1.94、P1.40～1.60，并用萤石作矿化剂、二水石膏作缓凝剂配制而成。其抗压强度3天为496～503公斤力/厘米^2，28天为779～785公斤力/厘米^2，早期强度增进率3天/28天为63～68%，用于一般工程建筑及机场跑道、桥梁、隧道和紧急抢修等工程。由于本发明的烧成温度较宽，可节省大量能耗降低生产成本。

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权 利 要 求 书

①、一种早期和终期高強度波特兰水泥由硅酸三钙、硅酸二钙、铝酸三钙和铁铝酸四钙组成，其特征在于KH为0·905～0·930、n为1·80～1·94、P为1·40～1·60，熟料矿物的成分为（重量百分比）：C_3S 56·00～58·50%、C_2S 14·00～17·00%、C_3A 8·00～10·50%，C_4AF 11·00～13·50%。

②、根据权利要求①所述的波特兰水泥，其特征在于熟料的化学成分为（重量百分比）：SiO_2 20·20～21·50%、Al_2O_3 6·20～6·80%、Fe_2O_3 4·10～4·45%、CaO 64·00～65·50%、MgO 2·50～3·10%、SO_3 1·20～1·50%、CaF_2 0·30～0·60%。

③、根据权利要求②所述的波特兰水泥，其特征在于熟料中掺入了（重量百分比）：$CaSO_4\cdot 2H_2O$ 4·50～6·00%。

④、一种早期和终期高強度波特兰水泥的配料方法，其特征在于生料中配入了（重量百分比）：0·45～0·90%的CaF_2作矿化剂。

⑤、根据权利要求④所述的波特兰水泥的配料方法，其特征在于液相量：C_3A+C_4AF的和为22·0～23·5%。

说　　明　　书

早期和终期高强度波特兰水泥及其配料方法

本发明属于建筑材料技术领域。

波特兰水泥是世界上使用范围最广，用量最大的水泥品种，尤其在土木建筑工程领域中作为主要建筑材料被广泛使用。

制造波特兰水泥的原料普遍易得，其工艺成熟具有多方面的良好性能，但它的早期和终期强度与特种高强度的水泥品种相比尚存在着一定的不足。

根据《水泥新标准选编》（国家建筑材料科学研究院水泥所 1985 年 1 月编辑）所述：“我国水泥与其他国家相比普遍存在早期强度偏低现象。……但早期强度指标的提高大部份厂在生产上有困难，实际上难于实行。”要使我国水泥赶上国际水平标准，早期强度指标的提高是个重要方面。

《水泥物理性能及其检验》上册（国家建筑材料科学研究院水泥所 1 9 8 2 年 6 月出版）一书第二章第一节“硅酸盐水泥”一文所述：我国出口的五羊牌波特兰水泥一般 3 天的抗压强度可达到 2 8 天的 5 0——5 7%，7 天可达到 7 3——7 8%。这种水泥与掺入了混合材料的水泥相比其早期强度比较高，但与早期和终期高强度的特种水泥，如高铝水泥、硫铝酸盐等水泥相比其强度则较低。

1 9 7 8 年 1 2 月 3 0 日苏联专利文献 S U——639828 中公开的《粘合料》，是在波特兰水泥熟料中添加石膏和含碱铝代硅酸盐物料高

温化学处理产物的添加剂。其抗压強度３天为２７０公斤力／厘米^2，28天为５６６公斤力／厘米^2 这种掺入添加剂的波特兰水泥需经热化学方法处理，工艺较为复杂，其早期和终期強度仅相似于我国５２５标号波特兰水泥标准。

１９８０年３月２６日日本专利文献ＪＰ——80011632中公开的《水泥混合料》，是在波特兰水泥中添加由铝酸钙、硫酸钙和碳酸钠的混合料。其抗压強度１天为２０５公斤力／厘米^2，２８天为５１２公斤力／厘米^2 这种水泥２小时和５小时的快硬強度较高，但早期和终期強度较低，相似于我国４２５标号快硬波特兰水泥标准。

１９８０年１１月２７日日本专利文献ＪＰ——80046984中公开的《早高強水泥》，是在波特兰水泥中添加铝酸钙和硫酸钙能产生２小时強度，其１天抗压強度为３９６公斤力／厘米^2，终期強度为５７４公斤力／厘米^2，这种水泥快硬強度较高，仅超过我国４２５标号快硬波特兰水泥标准，但終期強度并不高。

１９８１年２月２０日日本专利文献ＪＰ——56017959中公开的《高強度砂浆和混凝土的制造方法》，是在波特兰水泥中添加特殊硬石膏和二氧化硅质物料及氧化铝质物料的混合料制成的砂浆在５０——１００℃加热处理，其早期強度３天为４３９公斤力／厘米^2，终期強度为８７９公斤力／厘米^2，早期強度增进率为６５%。用这种方法配制的水泥早期和终期強度有所提高，相似于我国６２５标号波特兰水泥标准，但其砂浆需加热处理，施工中较不方便。

1981年8月15日苏联专利文献SU——854906中公开的《粘合料》，是在波特兰水泥熟料中掺入含碱金属或碱土金属、木质素磺酸盐、碱金属碳酸盐或硅酸盐和单糖，以提高混凝土蒸气养护后的抗压强度，其抗压强度1天为675公斤力/厘米^2，28天为703公斤力/厘米^2，这种水泥1天的强度较高，但1天以后增长很少，相似于我国625标号早强型波特兰水泥标准。由于它的添加物料多，制作工艺极为繁杂，而且又是价值较高的化工原料作添加物，因而生产成本较高。

1982年1月18日日本专利文献JP——82002667中公开的《早强水泥的制法》，是先生产出不含C_3S的特殊水泥熟料后加入70%的波特兰水泥混合磨制而成。其抗压强度3天为175公斤力/厘米^2，28天为395公斤力/厘米^2，早期强度增进率为44%。这种方法制成的水泥早期强度有所增长，但终期强度仅相同于普通波特兰水泥，而且其工艺也极为复杂。

上述国外专利文献中所述的波特兰水泥其共同特点施工性能一般良好，国外在研制提高波特兰水泥早期和终期强度所取得的效果方面作了些努力，但尚存在些不足，如有的水泥早期强度较高，终期强度则低，有的终期强度较高，早期强度则低，而且它们的快硬或早強普遍又都是在波特兰水泥或者波特兰水泥熟料中添加了快硬或早強物料混合制成的，其生产工艺繁杂，有的甚至采用了价值较高的化工原料作添加物使生产成本增高。

它们的2小时、5小时和1天的强度较高，只能适用于对快硬有特

殊要求的工程上。但3天和28天抗压強度并不高。因此在使用上有着较大的局限性。它们有的需在50——100℃之间加热处理后才可能提高其快硬或早強，在工程施工中使用极不方便。

能否利用一般生产波特兰水泥熟料的原料和工艺，研制一种改善波特兰水泥熟料的性能，并在不掺入任何添加物料的前提下使波特兰水泥同时具备快硬早強和终期高強两个重要特性，这在目前国内外波特兰水泥中是没有的。

本发明人针对国内外波特兰水泥中所存在着的上述尚未实现的问题，经过认真研究完成了本发明。

本发明的目的是研制一种同时具备早期和终期高強度的波特兰水泥，另一个目的是提供配制上述波特兰水泥的方法。

本发明是这样实现的，要使波特兰水泥同时具备快硬早強和终期高強两个重要特性提高早期強度增进率，其关键在于着重调整好石灰饱和比（K_H）、硅酸率（n）、铝氧率（p）这三个率值之间相辅相成和互相制约的关系，采用"三率值"的"两高一低"法，即K_H为0·905——0·930，n为1·80——1·94，p为1·40——1·60。同时确定C_3S、C_2S、C_3A和C_4AF为主要矿物，并调整它们之间合理的比例关系，其熟料矿物的组成为（重量百分比）：C_3S 56·00——68·50%，C_2S 14·00——17·00%，C_3A 8·00——10·50%，C_4AF 11·00——13·50%，MgO及其它2·50——3·94%。

本发明采用的石灰饱和比和C_3S都高，由于C_3S的水化合物反应速度凝结硬化快以及四大矿物合理的比例关系，促使波特兰水泥早期和终期強度能够同时提高。

对熟料的化学成分控制为（重量百分比）：SiO_2 20·20——21·50%、Al_2O_3 6·20——6·80%、Fe_2O_3 4·10——4·45%、CaO 64·00——65·50%、MgO 2·50——3·10%、SO_3 1·20——1·50%、CaF_2 0·30——0·60%，在熟料中加入（重量百分比）：$CaSO_4·2H_2O$ 4·50——6·00%。

在提高石灰饱和比时往往会给烧成带来一定的困难因而不能获得高強度的熟料，本发明针对这一问题在配料时配入了矿化剂，经试验由如下表1验证选用了CaF_2作矿化剂，用量为0·45——0·90%。

表1：三种矿化剂分别试验后的抗压、抗折強度和早期強度增进率比较

矿化剂名称	抗压強度（公斤力／厘米²）			早期強度增进率（%）	抗折強度（公斤力／厘米²）			早期強度增进率（%）
	3天	7天	28天		3天	7天	28天	
二水石膏	496	606	785	63	67	77	84	78
部分石膏和萤石	496	612	722	68	73	87	92	79
萤石	503	634	779	65	79	88	100	79

当本发明因配入了0·45——0·90%的CaF_2作矿化剂而促使烧成温度降低110——120℃左右，使液相出现的时间也就提前，促成C_2S与Cao化合生成大量的C_3S，同时还配有足够的液相量，使C_3A+C_4AF的和保持在22·0——23·5%。

由于采用了适当的铝氧率即适量多的C_3A和较少量的C_4AF就限制了铁量，避免了在烧成中生成熔融大块和减少炼边及结瘤事故的发生，使烧成顺利。

适量的C_3A（8·0——10·6%）是促进波特兰水泥快硬早強的重要因素，适量即可保证早期强度的需要，但过量时会造成液相的粘度增大有碍于C_3S的生存。

实现本发明时在熟料中还应加入二水石膏（$CaSO_4\cdot 2H_2O$）作缓凝剂，使初凝时间不早于45分钟。波特兰水泥中含有SO_3不得大于3·5%，加入的二水石膏以4·50——6·00%为宜。

本发明配制的水泥物理性能按照国家标准检测如下表2。

表2：本发明水泥的物理性能试验数据

标准稠度（%）	凝结时间（时：分）		安定性	強度（公斤力／厘米²）					
				抗压			抗折		
	初凝	終凝		3天	7天	28天	3天	7天	28天
29·00	1:12	1:42	合格	603	634	770	[illegible]	[illegible]	100

用本发明所配制的水泥与国家新增７２５标号早强型波特兰水泥标准的抗压、抗折强度和早期强度增进率比较如下表３。

表３：两种水泥的抗压、抗折强度和早期强度增进率比较

水泥名称或标号	抗压强度（公斤力/厘米^2）			早期强度增进率（%）	抗折强度（公斤力/厘米^2）			早期强度增进率（%）
	3天	7天	28天		3天	7天	28天	
新增725 R波特兰水泥	377		725	52	63		88	72
本发明水泥	503	634	779	65	79	88	100	79

本发明的水泥与国家新增７２５标号早强型水泥相比其３天早期抗压强度超出１２６公斤力/厘米^2，抗折強度超出１６公斤力/厘米^2，早期抗压強度增进率高于我国目前平均水平（我国早期抗压强度增进率平均水平为４９·８％），也高于世界目前平均水平（世界早期抗压強度增进率平均水平为５２％）。

本发明在遵义市十字水泥厂磨机的喂料装置和生、熟料库未安装前进行了工业试验并按照国家标准检测如下表４。

表４：本发明水泥工业试验的物理性能检测数据（在上述条件下进行）

标准稠度 (%)	凝结时间 (时：分)		安定性	细度 (%)	游离钙 (%)	強度（公斤力／厘米²）					
						抗压			抗折		
	初凝	终凝				3天	7天	28天	3天	7天	28天
26	1:19	3:15	合格	12	2·7	428	554	763	62·8	71	90·8

实施本发明的最佳方式：

1、KH为0·910——0·920、n为1·80——1·90、P为1·40——1·50。

2、熟料矿物的组成为（重量百分比）：C_3S 56·00——57·00%、C_2S 14·00——15·00%、C_3A 8·00——9·00%、C_4AF 12·00——13·00%、Mgo及其它2·50——3·00%。

本发明由于改进了波特兰水泥的性能因而能同时具备快硬早強和高強两种重要特性，是一种新型水硬性胶凝材料，其3天早期強度高于快硬波特兰水泥，28天终期強度高于高铝水泥，体现了本发明的波特兰水泥优良的物理性能和具有特殊的使用价值及广泛用途。它不仅能保持和用于原来的工程建筑及预制品，还可配制特殊高标号的混凝土，适用于机场的跑道、桥梁、隧道和紧急抢修等工程。

配制本发明的水泥不需外加任何快硬或早强添加物，其砂浆也不需加热处理，生产工艺简单，能够用原生产波特兰水泥的生产设备制作。

本发明的水泥由于早期强度高、安定性和施工性能良好因此可加快工程的施工进度，缩短工期节省施工费用，有利于推广使用。

用本发明的水泥熟料适量掺入混合材料可配制高标号的混合水泥，以提高产品标准、也可以多掺入混合材料提高产量，节省大量能耗、降低生产成本、其社会经济效益不论生产厂还是用户都是很明显的。

用含$SiO_2$38·11%、$Al_2O_3$27·70%、$Fe_2O_3$0·36%、CaO16·83%、MgO5·54%、MnO7·00%，其质量系数为1·11（低于国家标准）的锰铁冶金矿渣掺入本发明水泥的熟料配制。

实施例：

用60%的本发明的水泥熟料掺入40%的上述化学成分的锰铁冶金矿渣而配制了625标号性能的矿渣水泥。

根据实施例，若采用45%的本发明的水泥熟料掺入55%的矿渣即可配制525标号性能的矿渣水泥。如果原年产525标号波特兰水泥100,000吨的水泥厂，使用本发明的水泥熟料掺入55%的矿渣即可年产525标号矿渣水泥223,000吨、又如以525标号波特兰水泥熟料掺入55%矿渣的原年产325标号矿渣水泥100,000吨的水泥厂，使用本发明的水泥熟料可年产525标号矿渣水泥100,000吨、由于提高了两级标号能节省大量的能耗。

上述使用本发明的水泥熟料掺入混合材料配制混合水泥时，根据所掺入的混合材料的多少，应适当减少石膏用量。